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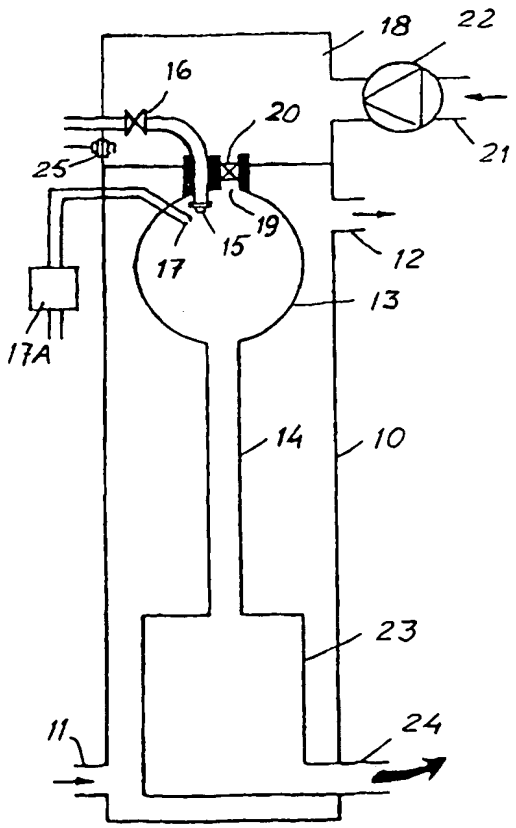
(57) Abstract

The invention covers a method and a device for supervision and control of a heat generator with pulsating combustion. The amplitude of the sound generated during the operation of the heat generator is sensed by means of a sensor (25), and the initiation means (17, 17A, 22) or electrical operative system of the heat generator is shut down, when the amplitude reaches a predetermined value, which indicates that the heat generator operates, or falls outside a predetermined area, which indicates that the operation of the heat generator is defective.



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A METHOD AND DEVICE FOR SUPERVISION AND CONTROL OF A HEAT GENERATOR WITH PULSATING COMBUSTION

Technical Field

The present invention relates to a method and device for supervision and control of a heat generator with pulsating combustion.

Background of the Invention

A heat generator of this type can be constructed in different ways, but in an exemplary commercially available variation it comprises a Helmholtz resonator with a resonant chamber arranged as a combustion chamber, a pulse tube connected to the combustion chamber at one of its ends, a decoupler with an exhaust pipe being connected to its other end, an inlet chamber with an initiation blower, a valve controlled by the pulse pressure in the combustion chamber for regulating the connection between the inlet chamber and the combustion chamber, a device for injecting fuel in the combustion chamber, and an ignition device for igniting the fuel in the combustion chamber.

When this heat generator is to be started or initiated, the initiation blower is started, which sucks in air in the inlet chamber and creates a certain overpressure, whereupon an ignition device (a spark plug) is activated, at the same time as fuel is injected, so that the fuel is ignited and herewith a rythmic movement of the valve can commence. When this has happened, however, the initiation blower and the ignition device shall be shut down, which of course should occur automatically by means of a suitable control system.

A heat generator of the type mentioned above must have a completely dependable supervision system, which determines whether it is operative or not. In a conventional furnace with an open fire this can occur by means of a

photocell or the like, but in a pulsating heat generator supervision may be difficult to attain.

Through SE-B-462 661 it is known to utilize the frequency of the pressure variations for this purpose. In this case the pressure variations in the inlet chamber are sensed, and their frequency is compared with a predetermined frequency, so that the ignition device and the initiation blower can be shut down, when the frequency of the pressure variations shows a requisite conformity with the predetermined frequency.

Certain problems and drawbacks are associated with such a frequency measurement. A furnace or heat generator has a certain resonant frequency for physical reasons, and this frequency is dependent on the construction and temperature of the furnace, type and quality of the fuel and air surplus, and so on. The frequency does not give a clear indication of the function of the heat generator; it would be advantageous to have a better signal of the generator function. It has also in practice appeared that the method with frequence measurement caused great problems in that an initiation which should have been approved has not actually been approved.

The Invention

A better way of supervising and controlling a heat generator or furnace of this kind is according to the invention attained in that the amplitude of the sound generated during the operation of the heat generator and/or the gas pressure is sensed and that the initiation means or electrical operative system of the heat generator is shut down, when the amplitude reaches a predetermined value or falls outside a predetermined area, respectively.

The shut down should here occur with a certain delay, so that for example singular pressure increases and explosions in the furnace are not taken as an indication of

approved operation or do not lead to the shut down of the furnace.

In a practical embodiment of a heat generator of the mentioned kind the amplitude in the inlet chamber is sensed and the ignition device and the initiation blower are shut down, when the amplitude reaches a predetermined value.

A supervising and controlling device for carrying out the method according to the invention has an electronic circuit device for emitting a signal for shutting down the initiation means or a signal for shutting down the electrical operative system of the heat generator at the receipt from a sensor of an amplitude signal over a predetermined value or outside a predetermined area.

This circuit device is preferably supplemented with a delay circuit.

In order to allow connection to a so called fire controller for the furnace, the electronic circuit device can be supplemented with an adaptation unit. The circuit device can in such a case be phantom fed with current from the fire controller.

In the practical embodiment described above the sensor can be arranged in the inlet chamber, and the initiation means can comprise the ignition device and the initiation blower.

The pressure connection of the sensor can here be provided with a snorkel, which extends down to the bottom of the inlet chamber. Oil or water which possibly leaks in will hereby lead to a shut down of the furnace, as the measured amplitude hereby decreases.

The invention is based on the principle that the sensor senses the amplitude for the sound generated at the combustion. The sensor therefore needs not be placed in the inlet chamber of the furnace - even if this is the preferred position - but may for example alternatively be positioned in the combustion chamber itself, between the fur-

nace body and the outer shell of the furnace or even completely outside the furnace.

At the initiation procedure for a furnace, which is presently preferred, currency is concurrently supplied to the ignition device in the form of an electrode and to an oil pump with an initiation blower on the same shaft, an oil valve being opened at the same time. When an approved initiation has occured, the blower continues to operate, whereas the electrode is shut off. A two stage oil pump can be utilized with a lower oil pressure during the initiation procedure and a higher pressure at operation. Variations of blower systems can be envisaged for meeting different demands. This is also true for the ignition device. For gas furnaces there is no need for a fuel pump, but here there are safety valves and so forth.

When the furnace is shut off, the currency supply to the oil pump and the oil valve is shut off. In certain cases post-ventilation with a blower can occur.

The supervision and control of the pulsating generator need not only cover the initiation, but it can be equally essential to shut off the electric operative system of the generator, when the sensed amplitude falls outside a predetermined area, which indicates that the operation of the furnace is defective.

The invention is equally applicable to all types of pulsating heat generators and is not limited to use at the embodiment chosen as an example.

There are reasons to believe that the control of pulsating heat generators will be computerized, and the invention is applicable also in such cases.

Brief Description of the Drawings

The invention shall be described in more detail below under reference to the enclosed drawings, in which Fig 1 is a very diagrammatic vertical sectional view of a heat generator with pulsating combustion and Figs 2 and 3 are block

diagrams of two embodiments of supervising and controlling devices according to the invention.

Detailed Description of Preferred Embodiments

The heat generator of the present type shown in Fig 1, which works with pulse combustion according to a previously known technique, is disposed in a water tank 10 with an inlet 11 and an outlet 12 for the water, which in a known way shall be circulated in a water based heating system. The heat generator comprises a Helmholtz resonator with a resonant chamber 13 and a pulse tube 14, which is connected to the resonant chamber at one of its ends. The resonant chamber forms the combustion chamber of the heat generator and is provided with a nozzle 15 for the supply of gaseous, liquid or fluidized fuel via a magnet valve 16 and with a spark plug 17, connected to an initiation transformer 17A. An inlet chamber 18 is connected to the combustion chamber through an air inlet 19, which is controlled by a valve 20. The valve is arranged to operate in an automatic fashion for alternately closing at a supra-atmospheric pressure in the combustion chamber and opening at a sub-atmospheric pressure therein in a rythmical movement. The inlet chamber communicates with the external air through an inlet 21, which is provided with an initiation blower 22, via a silencer and/or a filter.

The other end of the pulse tube is connected to a decoupler 23 having an exhaust pipe 24 connected to a chimney or other flue.

When the heat generator is in a normal mode of operation, the fuel injected in the combustion chamber 13 is ignited when entering the hot combustion chamber and will be burnt up in combination with the oxygen present in the combustion chamber, which results in a supra-atmospheric pressure and a closing of the valve 20 as a result of said supra-atmospheric pressure. When a subsequent sub-atmospheric pressure is created, the valve 20 is reopened to allow

an inflow of air in the combustion chamber from the inlet chamber 18, followed by another ignition and combustion of fuel. Thus, combustion pulses having a regular frequency are generated in the combustion chamber.

The heat generator is run intermittently in dependence of the temperature of the water in the tank 10 in a conventional way; when a predetermined increased temperature of the water is reached, the heat generator is turned off and then restarted, when the temperature is decreased to a predetermined lower temperature. At a restart of the heat generator after a stand period the fuel must be ignited externally by means of the spark plug 17 and air must be forced into the inlet chamber by means of the initiation blower 22. Thus, the ignition device and the initiation blower are turned on at start up, but must be turned off when the heat generator is in normal operation, such a function being defined as a self-ignition of the fuel and the air being injected by a sub-atmospheric pressure in the heat combustion chamber.

An example of a supervising and controlling device for the heat generator as shown in Fig 1 is shown in Fig 2. As shown in Fig 1, a sensor 25 is arranged in the wall of the inlet chamber 18. The sensor 25 has the purpose of sensing the amplitude of the sound and/or gas pressure in the inlet chamber. The sensor 25 is preferably of a piezo electric type, but other types can also be used.

The sound is supplied to the sensor 25 through a connection 25' in the inlet chamber 18. Memories 26 and 27, to which the signals from the sensor 25 are supplied, memorize the highest and the lowest acoustic pressure, respectively, which recently has been measured, i e the highest and the lowest signal, respectively, which has been supplied from the sensor 25. If a lower signal than the highest one or a higher signal than the lowest one is supplied to the memo-

ries 26 and 27, the memorized values are successively changed to the new input values.

Signals corresponding to the highest and lowest pressures are supplied from the memories 26 and 27 to a differentiator 28, where the lowest value of the signal is subtracted from the highest value, so that a signal corresponding to the signal amplitude is supplied to a further differentiator 29. Herein the obtained amplitude signal is compared with a predetermined minimum value for providing an output clearing signal if the amplitude signal, i e the amplitude to the sensor 25, is over the predetermined minimum level.

A device of this kind can be called an amplitude controller.

Fig 3 shows a version which is more developed in relation to the amplitude controller according to Fig 2. The description above of the device up to and including the emitted signal from the differentiator 29 is the same. This emitted signal is in this case supplied to a delay circuit 30, which has the function of only letting through otherwise approved signals with a certain, predetermined duration. In this way singular pressure increases or explosions in the heat generator will not be regarded as an approved operation.

It is customary that the operation of an ordinary heat generator is supervised by means of a so called fire controller, which can make use of a photocell as sensor. It can be suitable also for pulse furnaces of the kind described above to utilize such a fire controller, which is approved and cheap due to mass production. In order to be able to connect the amplitude controller according to the invention directly to such a fire controller it is required that the output draws much current at an approved amplitude and little current at a non-approved amplitude. This is

carried out by a unit 31, which emits a signal 32 directly to a photocell input of the fire controller (not shown).

The device can be supplemented with a so called phantom feeder, which means that for example a sensor can have its current supply through the same line as it emits its signal. Hereby, the current which the fire controller normally emits for reading the otherwise connected photocell be utilized as a driving current for all electronics in the amplitude controller. A separate current supply is thus obviated, which leads to a small amplitude controller circuit with a simple connection and a low cost. The device also becomes independent of utilized net currency.

The pressure connection 25' of the sensor 25 can be provided with a snorkel 33, which is arranged in the inlet chamber 18 of the furnace and extends down to its bottom. If liquid due to some defect leaks into the inlet chamber 18 and the liquid enters the snorkel 33, the measured amplitude decreases largely, which thanks to the function of the amplitude controller results in a shut down of the furnace, as an approved operation can not be indicated.

The amplitude controller according to the invention is preferably mechanically constructed for mounting together with the sensor at a suitable measurement position. Hereby the mounting is simplified and the frequency dependency is obviated that for example a connection hose would give rise to.

The practical embodiment described above is connected to a commercially available heat generator working with pulsating combustion. Other such heat generators are likewise possible for the device according to the invention.

It is thus possible to use constructions with one or more pulse tubes, exhaust chambers, exhaust tubes and/or valves. Further, it is possible in certain cases to obviate an initiation blower, and if the heat generator is equipped with an initiation blower, it does possibly not need to be

shut down after the initiation procedure. In the shown embodiment the ignition device comprises a spark plug, but alternatives such as glow means are possible. The device for fuel injection can be a carburettor or a spreader instead of an orifice. The decoupling chamber can lastly be connected to a bubble chamber or the like instead of an exhaust tube or a chimney.

CLAIMS

1. A method for supervision and control of a heat generator with pulsating combustion, **characterized** in that the amplitude of the sound generated during the operation of the heat generator and/or the gas pressure is sensed and that the initiation means (17, 17A, 22) or electrical operative system of the heat generator is shut down, when the amplitude reaches a predetermined value or falls outside a predetermined area, respectively.

2. A method according to claim 1, **characterized** in that the shut down occurs with a delay.

3. A method according to claim 1 at a heat generator comprising a Helmholtz resonator with a resonant chamber (13) arranged as a combustion chamber, a pulse tube (14) connected to the combustion chamber at one of its ends, a decoupler (23) with an exhaust pipe (24) being connected to its other end, an inlet chamber (18) with an initiation blower (22), a valve (20) controlled by the pulse pressure in the combustion chamber for regulating the connection (19) between the inlet chamber and the combustion chamber, a device (15, 16) for injecting fuel in the combustion chamber, and an ignition device (17, 17A) for igniting the fuel, **characterized** in that the amplitude in the inlet chamber (18) is sensed and that the ignition device (17, 17A) and possibly the initiation blower (22) are shut down, when the amplitude reaches a predetermined value.

4. A supervising and controlling device for carrying out the method according to claim 1 at a heat generator with pulsating combustion, **characterized** by an electronic circuit device (26-29) for emitting a signal for shutting down the initiation means or a signal for shutting down the electrical operative system of the heat generator at the receipt from a sensor (25) of an amplitude signal over a predetermined value or outside a predetermined area, respectively.

5. A device according to claim 4, **characterized** in that the electronic circuit device (26-29) is supplemented with a delay circuit (30).

6. A device according to claim 4, **characterized** in that the electronic circuit device (26-29) is supplemented by a unit (31) for adaption to a so called fire controller for the heat generator.

7. A device according to claim 6, **characterized** in that the electronic circuit device (26-29) has a so called phantom feed (33) of current from the fire controller.

8. A device according to any of claims 4 - 7 at a heat generator comprising a Helmholtz resonator with a resonant chamber (13) arranged as a combustion chamber, a pulse tube (14) connected to the combustion chamber at one of its ends, a decoupler (23) with an exhaust pipe (24) being connected to its other end, an inlet chamber (18) with an initiation blower (22), a valve (20) controlled by the pulse pressure in the combustion chamber for regulating the connection between the inlet chamber and the combustion chamber, a device (15, 16) for injecting fuel in the combustion chamber, and an ignition device (17, 17A) for igniting the fuel in the combustion chamber, **characterized** in that the sensor (25) is arranged in the inlet chamber (18) and that the initiation means comprise the ignition device (17, 17A) and the initiation blower (22).

9. A device according to claim 8, **characterized** in that a pressure connection (25') of the sensor (25) has a snorkel (33), which extends down to the bottom of the inlet chamber (18).

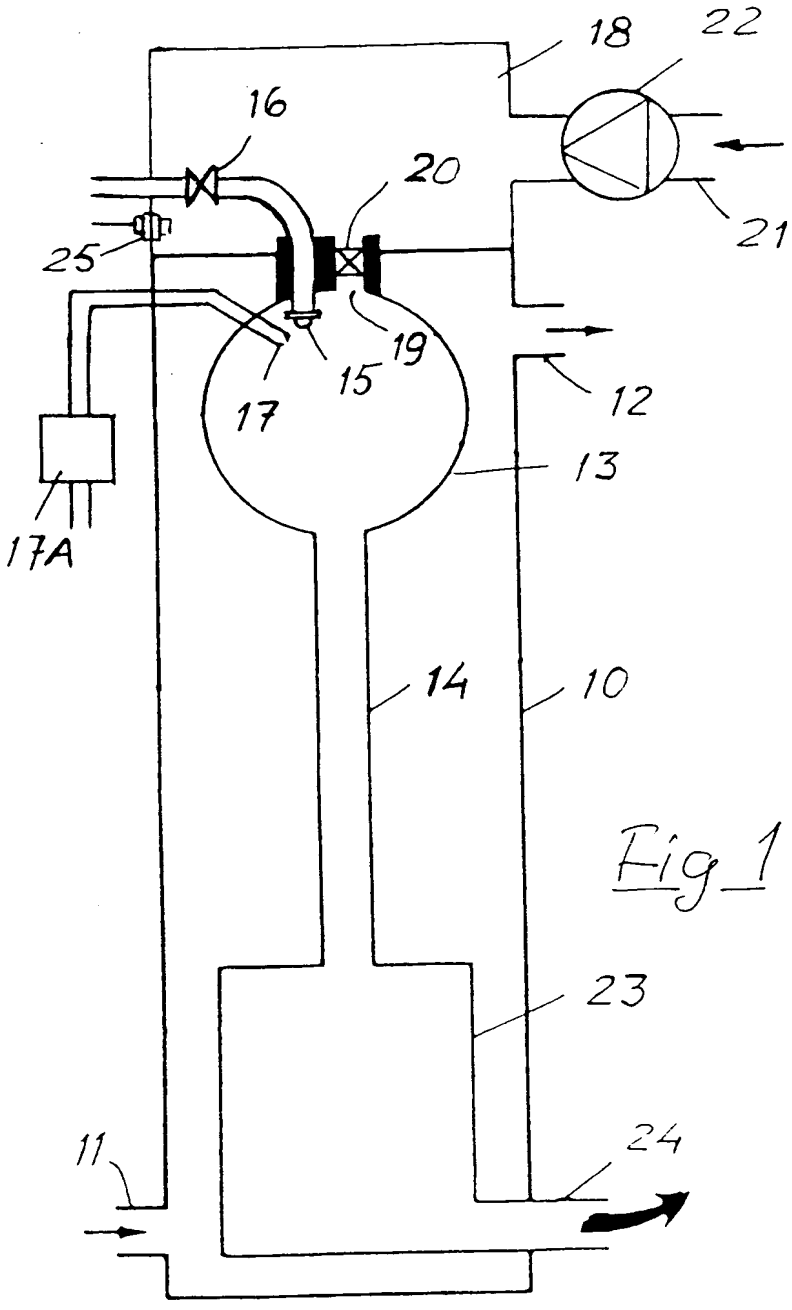

Fig 1

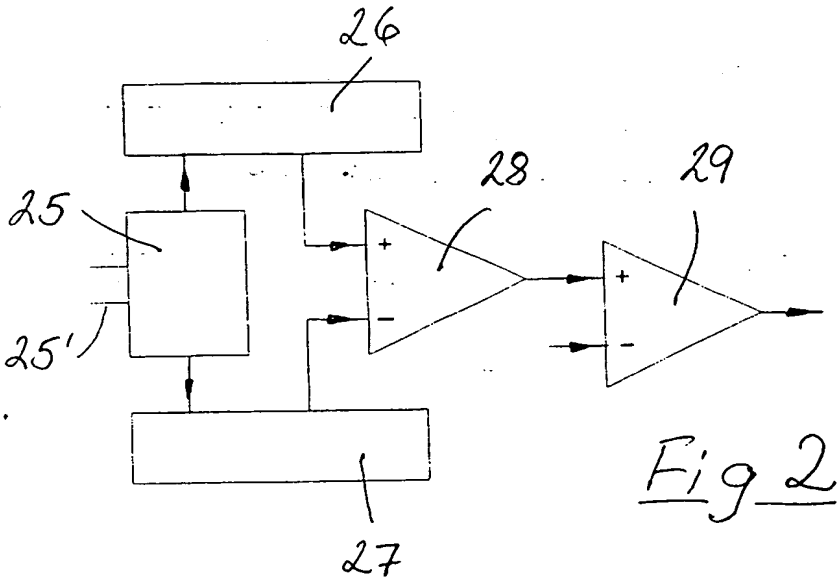

Fig 2

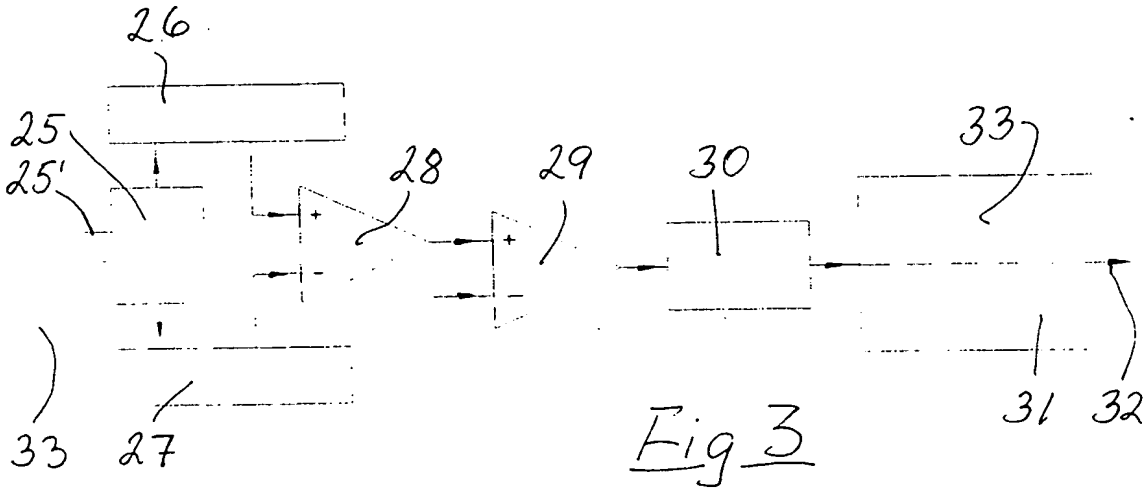

Fig 3

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F23C 11/04 // F23N 005/16
According to International Patent Classification (IPC) or to both national classification and IPC

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Minimum documentation searched (classification system followed by classification symbols)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SE 462661 B (PULSONEX AB), 6 August 1990 (06.08.90), abstract, fig. 1 -- --------	1-9

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
SE 462661 B	06/08/90	DE 3884408 D,T	17/02/94
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